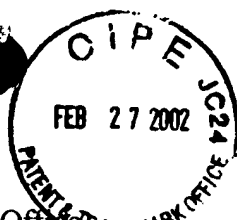


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Applicants:  
Savvas Vasileiadis,  
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1754  
#9/13  
3/12/2

Appl.#:09/525,176  
Filing date:03/14/00  
Art Unit:1754

Febr. 07, 2002

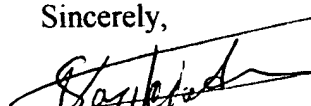
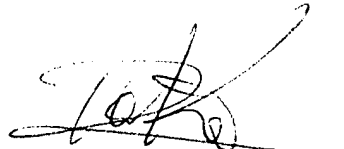
Completion of IDC in Response to Office Request of 1/29/2002

We complete the IDC by providing within, one copy of the reference titled:

-Environmentally benign hydrocarbon processing applications of single and integrated permreactors, by S. Vasileiadis and Z. Ziaka, published in "Reaction Engineering for Pollution Prevention", Elsevier Science Eds. (2000),

according to the Office request of 1/29/2002 concerning our patent application # 09/525,176.

Sincerely,

  
Savvas Vasileiadis, Ph.D. chemical engineering  
  
Zoe Ziaka-Vasileiadou, Ph.D. chemical engineering

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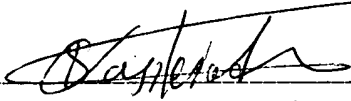
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PTO-1062 (4/96)

Ref #9

Dr. Savvas Vassiliades  
& Dr. Zoe D. Ziaka  
15549 Dearborn Str.  
North Hills CA 91343

tel. (818) 8934292

March 2, 1997

Dear Commissioner of Patents & Trademarks,

We are submitting to your office the following disclosure document titled: "Polymer Membrane Reactors for Enhanced Hydrocarbon Conversion & Upgrading" which was submitted as abstract at the 1997 AIChE Annual Meeting to be held at Los Angeles on Nov. 1997.

Within the document we believe that there are novel patentable materials and therefore we are considering it as "invention disclosure document".

This document includes pages 1 through 5.

Sincerely Yours  
*Savvas Vassiliades*  
Savvas Vassiliades  
Zoe D. Ziaka  
Ph.D. Chemical Engineering  
Los Angeles

><HTML><HEAD><TITLE>Submission Acknowledgement</TITLE>  
></HEAD><BODY><H4>American Institute of Chemical Engineers 1997 Annual  
Meeting</H4><HR><H2>Acknowledgement of Successful PTP Submission</H2><HR>  
><H3>Email Acknowledgement</H3>  
An email acknowledgement has also been sent to the  
email address that you provided for the PTP Communicator as well as the  
authors with email addresses.

><H3>PTP Identification</H3>  
><B>NOTE:</B>  
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><H3>The Proposal To Present A Paper</H3>  
The following is a copy of your Proposal To Present A Paper that  
has been made available for the technical session chairs and  
administrators  
to view.

><HR>  
Paper Title:<BR>Polymer Membrane Reactors for Enhanced Hydrocarbon  
Conversion and Upgrading<HR>By:<BR>  
Savvas Vassiliades[Speaker]<BR>  
Zoe D. Ziaka

><HR>Paper Description:<BR>  
Stiff polymers of high glass transition temperature can act as molecular sieve  
reactors  
for gaseous-hydrocarbons upgrading reactions. Applicable process designs of  
such modules are investigated.<HR>Abstract Body: (Abstract Body Format:  
html)<BR> <HTML>  
><BODY>  
><P><B>

>High glass transition temperature polymer were utilized as reactors in  
tubular  
catalytic hollow fiber configurations for conducting gas-phase catalytic  
hydrocarbon reforming, oxidation  
and water gas shift reactions. Permselectivities of those materials to  
reaction  
products such as H<sub>2</sub>, CO<sub>2</sub>, C<sub>2</sub>H<sub>4</sub>, CH<sub>3</sub>OH are considerably high and competitive  
with regard to those of other currently available porous and dense membrane  
reactor materials. High packing capacity of the hollow fiber fixed-bed  
membrane reactors  
within the overall reactor module offers large surface areas available for  
permeation

and product separation.

</B></P>

<HR>

<P><B>

The membrane reactors were tested under various modeling operating conditions of the methane steam reforming, the water-gas shift and the partial oxidation of methane reactions to project suitable process designs for application. Materials and especially polymer, reaction and separation engineering principles and operations were combined to yield optimum applicable designs for the process industry. Physical properties of the membrane materials were combined with thermodynamic properties of the molecules involved in permeation process to design long term operation membrane reactors. </B></P>

<HR>

<P><B>

Integrated polymer membrane reactors as well as consecutive placed conventional reactors with polymer membrane permeators were designed and characterized computationally. The lower temperature operation of these reactors increases the process efficiency together with substantial increase in the catalyst life time.

In overall comparison with conventional reaction-separation systems these reactors

can provide effective cost reduction in process equipment and operations; improved

hydrocarbon conversion, recycling and utilization; enhanced product recovery; and overall calorific value gas for chemical synthesis or energy generation.

</B></P>

<HR>

<P><B>

Improved materials and energy transformation makes them highly competitive as environmentally benign chemical processes. Currently available industrial technology for membrane based gas separations makes the new reactor designs imminent candidates for large scale natural gas and hydrocarbon feedstock conversion and upgrading.

</B></P>

</BODY>

</HTML>

<HR>Paper Key Words:

<BR>polymer membrane reactors, hydrocarbon steam reforming, hydrocarbon oxidation, water gas shift, membrane reactor process design

<HR>

Paper URL:

<BR>

<A HREF="http://www-rcf.usc.edu/~vasileia">

<STRONG>http://www-rcf.usc.edu/~vasileia</STRONG></A><HR>Author

Contact Information:<BR><P>

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AIChE, North American Catalysis Society, Materials Research Society,  
International Platform Association<BR></UL><HR>PTP Communicator:<BR><P>

Savvas Vassiliades<UL>Email Address:

<A HREF="mailto:vasileia@rcf.usc.edu">vasileia@rcf.usc.edu</A>><BR>Postal Address: 15549 Dearborn Str.<BR> North Hills, CA USA 91343<BR>Phone: 818-893 4292<BR>Fax: 213-744 1426<BR></UL><HR>PTP Sent By:<BR><P>

Savvas Vassiliades<UL>Email Address:

<A HREF="mailto:vasileia@rcf.usc.edu">vasileia@rcf.usc.edu</A>><BR> , <BR>Phone: 818-893 4292<BR>Fax: 213-744 1426<BR></UL><HR>Submission Comments:<BR>

This is a continuation of our R&D work for designing, modeling and practically implementing efficient integration of reaction and separation processes and in particular permselective reactor-separator designs for natural gas and hydrocarbon feedstocks

conversion and upgrading.<P>Submitted:Fri Feb 28 23:37:07 1997<BR>Last Updated:Fri Feb 28 23:37:07 1997<BR>Submitted From: http://www1.che.ufl.edu/meeting/1997/annual/bin/ptp.cgi/action/author/2?5uKVTBiw<BR>Browser: Mozilla/3.0 (X11; I; SunOS 5.5.1 sun4m)<BR>Remote Host: sal-sun103.usc.edu<BR><HR>This PTP is being submitted to the following sessions:<UL><LI>[20z28]

<A HREF="/meeting/1997/annual/cfp/20z28/">

<STRONG>Developments in Kinetics, Catalysis and Reaction Engineering</STRONG></A><BR><UL>Chair:

Ralph

Pike <BR>

Email: <A HREF="mailto:chepik@lsuvm.sncc.lsu.edu">chepik@lsuvm.sncc.lsu.edu</A> <BR>

Phone: 504-388-3428 <BR>

Fax: 504-388-1476</UL></UL>For further information, check with the Chairs of the technical sessions to which you submitted your PTP.<H3>Select The Next Action To Be Taken:</

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New PTP</A>
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withdraw?iZ44D2Mh">Withdraw A PTP</A>
  <LI><A HREF="/meeting/1997/annual/bin/ptp.cgi/quit?iZ44D2Mh">Quit</A>
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— In addition to the above disclosure described in the abstract we would like to disclose the concept of a "Double wall membrane reactor" in which two permselective wall membrane reactors are placed so that one membrane reactor will be within the other. As an example a double permselective wall tubular reactor can be fabricated so that the inner cylinder will consist of the first permselective material and the outer cylinder will consist of the second permselective material. The membrane materials in the double cylinder can be the same or different so that they can separate <sup>the same or</sup> different species. Some species (usually in the gas phase) will be separated through the first permselective wall cylinder and out of those some will be separated consequently through the second permselective wall cylinder (outer cylinder).

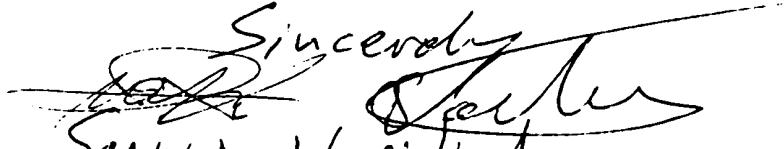
In a similar fashion multiple wall membrane reactors can be fabricated to act correspondingly for separation of complex mixtures.

These membrane materials can be polymers, ceramics, metals, metallic catalysts such as zeolites or other molecular sieving catalysts or any other suitable permselective materials.

Also they can be composites of those mentioned materials.

The above described concept can be applied for separation only (e.g., double or multiple wall separators) or for combination of reaction and separation processes (e.g., double or multiple wall reactors & separators placed one within the other).

3/2/97

Sincerely  
  
Zoltan Zoltan

Zoe D. Zoltan